REMARKS

Claims 1, 3-9, and 11-25 are now pending in this application, with claims 1, 9, 17, 18, and 22 being in independent form. Claims 1, 3, 5, 7, 9, 11, 13, 15, and 17 have been amended; claims 2 and 10 have been canceled without prejudice or disclaimer of subject matter; and claims 18-25 have been added.

Claim 17 was rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent Application Publication No. US 2002/0027702 to Kitamura et al. (hereinafter "Kitamura"). Claims 1-17 were rejected under 35 U.S.C. § 103(a) as being obvious from Kitamura in view of Dai Nippon Printing Co. JP 2000-214750 (hereinafter "Dai Nippon") in view of Nippon Telegraph and Telephone Corp. JP 2002-72838 (hereinafter "NTT").

Applicants submit that independent claims 1, 9, 17, 18, and 22, together with the claims dependent therefrom, are patentably distinct from the cited references for at least the following reasons.

The present invention is intended to eliminate unnecessary noise components generated during observation. As described, e.g., in Section 3 of the present specification, the inventor found the reasons why such noise components are generated. That is, when one prepares seven types of binary patterns D0 to D6 shown in Fig. 9 and puts them on respective calculation points Q(x, y) shown in Fig. 2, a black stripe periodic pattern or a white stripe periodic pattern as shown in an example of Fig. 11 is observed as noise components. By virtue of the features of the present invention, such noise components can be eliminated.

Applicant offers the following initial comments regarding the independent claims.

Claim 1 is directed to a method using reference light, and unit areas as shown for example in Fig. 9 of the present application. Claim 1 as amended is based on the original claim 1 with

the subject matter of original claim 2 incorporated therein. In the claim, the recitation "which is supposed to be observed in a lighting environment of the real world where a multiple of light sources exist" is supported by the specification, at least at page 2, lines 21-22, and page 14, lines 9-10. Furthermore, the recitation "defining a predetermined original image in a three-dimensional coordinate system, a recording surface placed in the coordinate system" is supported by the specification, at least at page 7, lines 22-26. Moreover, the recitation "wherein a rectangle is used as the unit area, and the binary pattern is formed by arranging the first area formed of a rectangle having a vertical width equal to a vertical width of the unit area and having a horizontal width according to a predetermined occupancy ratio at an approximately center position with respect to a horizontal width of the unit area and providing a remaining part as the second area" is based on the original claim 2.[1]

Similar comments apply to claim 9, which is directed to a method using no reference light, and unit areas as shown for example in Fig. 9.

Claim 17 is directed to a computer hologram medium.

New claim 18 is directed to a method using reference light and any unit areas such as those shown for example in Figs. 9 and Figs. 14-16. Claim 18 is similar to original claim 1, with the recitation "wherein both of a horizontal pitch and a vertical pitch of the calculation points are set equal to or less than a minimum wavelength of a visible light."

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[1]It is of course to be understood that the references to various portions of the present application are by way of illustration and example only, and that the claims are not limited by the details shown in the portions referred to.

New claim 22 is directed to a method using no reference light and any unit areas such as those shown for example in Figs. 9 and 14-16. Claim 22 is similar to original claim 9, with the recitation "wherein both of a horizontal pitch and a vertical pitch of the calculation points are set equal to or less than a minimum wavelength of a visible light."

Independent Claims 1 and 9

According to amended claims 1 and 9, a rectangle is used as a unit area, and a binary pattern such as any one of D0 to D6 shown in Fig. 9 of the present application is formed by arranging the first area (the hatched part in Fig. 9) formed of a rectangle having a vertical width equal to a vertical width of the unit area and having a horizontal width according to a predetermined occupancy ratio at an approximately center position with respect to a horizontal width of the unit area and providing a remaining part as the second area.

When using binary patterns having a particular configuration as shown for example in Fig. 9 of the present application, noise components might be observed as shown in Fig. 11. In order to eliminate the noise components, the method claimed in amended claims 1 and 9 has a unique feature that a horizontal pitch of the calculation points defined on the recording surface is set equal to or less than a minimum wavelength of a visible light. According to binary patterns D0 to D6 shown in Fig. 9, a horizontal width of the first area (the hatched part) has variations ranging from 100% to 0% of the full width of the rectangle unit area, and the variations of the horizontal width cause a black stripe periodic pattern or a white stripe periodic pattern as shown in Fig. 11 which produces noise components. Therefore, if a horizontal pitch of the calculation points defined on the recording surface is set equal to or less than the minimum wavelength of visible light, a periodic pitch of the black or white

stripe pattern also becomes equal to or less than the minimum wavelength of visible light so that noise components having a wavelength of visible light are not observed.

Kitamura discloses a three-dimensional cell C(x, y) in Fig. 8. However, a horizontal width of the cell is C1=0.6 μm (a wavelength of visible light), though a vertical width of the same is C3=0.25 μm. Dai Nippon (JP2000-214750) discloses a square cell constituting five binary patterns D0-D4 in Fig. 9 having a horizontal width of 2.0 μm (more than the maximum wavelength of visible light) and also discloses a rectangular cell constituting seven binary patterns D0-D6 in Fig. 14 having a horizontal width of 0.6 μm (a wavelength of visible light). Therefore, neither Kitamura nor Dai Nippon discloses the recitation of claims 1 and 9 in which "a horizontal pitch of the calculation points defined on the recording surface is set equal to or less than a minimum wavelength of a visible light".

Practically, it is very hard to commercially produce even a cell having a horizontal width of C1=0.6 μm as shown in Fig. 8 of Kitamura. Therefore, a person having ordinary skill in the art does not try to further reduce the horizontal width of the cell. He may be trying to increase the horizontal width of the cell in order to make a commercial production process easier. In such a practical viewpoint, it would not have been obvious to a person having ordinary skill in the art to reduce the horizontal width of the cell to become less than the minimum wavelength of visible light.

NTT discusses that <u>a sampling pitch of a hologram</u> is set equal to or less than <u>a wavelength in the air of a light which is used for reproduction</u> of the hologram, but does not teach that <u>a pitch of calculation points at which a binary pattern having occupancy ratios corresponding to interference wave intensities</u> is set equal to or less than <u>a minimum wavelength of a visible light</u>, as recited in claims 1 and 9.

As a matter of fact, a hologram recording medium of NTT and that of the present invention are different as optical products. In paragraph [0002] of NTT, it is stated that "As shown in Fig. 1, when laser light 4 focused by lens 3 is induced into a side end of hologram card 5, laser light 4 proceeds inside hologram card 5 trapped near core layer 1." Also in paragraph [0004], it is mentioned that "Hologram image 9 includes hologram information in waveguide pass and the information can be read out by observing the image by an image capture device such as CCD." And in paragraph [0007], it is mentioned that "Observation is made by an image capture device placed on focused plane 11 to obtain a reproduced image (hologram image)". Further, in paragraph [0016], it is stated that "In this embodiment, a semiconductor laser of 680nm in wavelength is used for reproducing hologram. Two kinds of hologram samples are made by calculation process, where a square unit cell of 1.675 μm in size is allocated in one sample and a square unit cell of 0.583 μm in size is allocated in another sample. When a semiconductor laser light of 680nm in wavelength is induced into respective hologram cards containing these two hologram samples, almost an expected image is reproduced from either one."

Therefore, a hologram recording medium of NTT is supposed to be observed on a display screen <u>via a CCD camera</u> when a laser light 4 is induced into a side end of hologram card 5, as shown in Fig. 1 or Fig. 2. On the contrary, a hologram recording medium of the present invention is supposed to be observed <u>in a lighting environment of the real world where a multiple of light sources exist</u>. One does not need to prepare a CCD camera, a display, or a laser light. One can observe a reproduced image directly by the naked eye in his room.

Second, one can observe only a two-dimensional image from a hologram recording medium of NTT. As shown in Fig. 2 of NTT, a two-dimensional image 9 (the tulip) is reproduced on focused plane 11, and the image 9 is captured by a CCD camera. On the contrary, according to the present invention, an original image in a three-dimensional coordinate system is recorded and reproduced.

Further, in a hologram recording medium of NTT, though a square cell or a hexagonal cell is allocated on a recording medium, each cell has a solid pattern in a whole area such as a white solid cell, a light grey solid cell, a heavy grey solid cell, or a black solid cell, as shown in Fig. 5. On the contrary, claims 1 and 9 recite a hologram recording medium with a cell having binary patterns each defined by dividing a unit area having a fixed form and size into a first area having a first pixel value and a second area having a second pixel value by changing an occupancy ratio of the first area relative to the unit area, as shown for example in Figs. 9 and 14-16 of the present application.

NTT recites, in claim 1 of that document: "A hologram information recording medium characterized in that a sampling pitch of hologram recorded in waveguide plane is set equal to or less than a wavelength in the air of a light which is used for reproduction of the hologram." Therefore, NTT does not disclose that a pitch of calculation points at which a binary pattern having occupancy ratios corresponding to interference wave intensities is set equal to or less than a minimum wavelength of a visible light, as recited in claims 1 and 9. As mentioned above, a hologram recording medium of NTT and that of the present invention are different as optical products. According to NTT's technology, there is no motivation to eliminate unnecessary noise components caused by a black stripe periodic pattern or a white stripe periodic pattern as shown in an example of Fig. 11. A person having ordinary skill in

the art recognizes that NTT's hologram and Kitamura's (or Dai Nippon's) hologram are based on different technologies, respectively, and NTT's technology has nothing to do with Kitamura's (or Dai Nippon's) technology.

For at least the foregoing reasons, claims 1 and 9 are seen to be patentable over the cited references.

Independent Claims 17, 18, and 22

According to claim 17, unit areas are arrayed horizontally and vertically so as to form a two-dimensional array on the medium, and both of a horizontal pitch and a vertical pitch of the unit areas are set equal to or less than 400nm. According to claims 18 and 22, calculation points are arrayed horizontally and vertically so as to form a two-dimensional array on the recording surface, and both of a horizontal pitch and a vertical pitch of the calculation points are set equal to or less than a minimum wavelength of a visible light. By virtue of these features, unnecessary noise components generated during observation can be eliminated.

Kitamura discloses a three dimensional cell C(x, y) in Fig. 8. A horizontal width of the cell is C1=0.6 μm and a vertical width of the same is C3=0.25 μm. Therefore, a horizontal pitch of the cell becomes C1=0.6 μm (a wavelength of visible light), though a vertical pitch of the cell becomes C3=0.25 (less than a wavelength of visible light). Dai Nippon (JP2000-214750) discloses a square cell in Fig. 9 having a horizontal width of 2.0 μm (more than the maximum wavelength of visible light) and also discloses a rectangular cell having a horizontal width of 0.6 μm (a wavelength of visible light). Therefore, neither Kitamura nor Dai Nippon discloses "both of a horizontal pitch and a vertical pitch of the unit areas are set equal to or less than 400 nm", as recited in claim 9, or "both of a horizontal pitch

and a vertical pitch of the calculation points defined on the recording surface are set equal to or less than a minimum wavelength of a visible light", as recited in claims 18 and 22.

NTT teaches a sampling pitch of a hologram is set equal to or less than a wavelength in the air of a light which is used for reproduction of the hologram, but does not teach a pitch of calculation points at which a binary pattern having occupancy ratios corresponding to interference wave intensities is set equal to or less than 400 nm or a minimum wavelength of a visible light. As mentioned above, a hologram recording medium of NTT and that of the present invention are different as optical products. Therefore, one having ordinary skill in the art recognizes that NTT's hologram and Kitamura's (or Dai Nippon's) hologram are based on different technologies, respectively, and NTT's technology has nothing to do with Kitamura's (or Dai Nippon's) technology.

For at least the foregoing reasons, claims 17, 18, and 22 are seen to be patentable over the cited references.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual consideration or reconsideration, as the case may be, of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicant respectfully requests favorable reconsideration and early passage to issue of the present application.

Respectfully Submitted

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